DAIRY RESEARCH

By Sabine Mann, Daryl Nydam and Thomas Overton

Feed a controlled energy diet during the dry period to prevent negative energy balance and disease, and improve colostrum quality, without impacting milk yield.

Dry cow feed strategies to control ketosis and colostrum quality

A successful transition of dairy cows from the dry period into early lactation is reflected by preventing disease and ensuring their profitability. During this time a certain degree of negative energy balance is unavoidable as cows break down fat and muscle tissue to supply energy for the increasing milk production. Excessive mobilization of these resources is detrimental for the health of cows, leading to milk production loss, poor fertility and increased risk for removal from the herd. Research efforts have thus concentrated on both pre- and postpartum management strategies to identify nutritional, housing and preventive measures that can be used to aid in the smooth transition of cattle. Nutritional strategies for dry cows have varied in the last decades with several different ones being used on dairy farms today. Limiting energy intake before calving has been recommended to achieve an optimal transition.

Some of the benefits of these controlled energy diets were shown in trials where animals were not fed ad libitum. Because applicability for modern dairy farms does require a diet offered ad libitum, often with the inclusion of monensin, in this study TMRs were fed to allow for at least 5% refusals and monensin was included in all rations.

Since research has shown a link between elevated concentrations of ketone bodies, such as ß-hydroxybutyrate (BHBA), in the bloodstream of dairy cows and disease risk after calving, we were particularly interested in studying the effect of different dry cow feeding strategies with different levels of fiber and starch on the occurrence and severity of ketosis and colostrum quality.

To investigate three different dry cow rations and closely study the effects during both the pre- and postpartum period, a Cornell University research study enrolled cows from the University´s research herd 57 days before expected parturition. Treatments differed in the energy level supplied and were formulated with the Cornell Net Carbohydrate and Protein System (CNCPS, version 6.1). Cows were either fed a diet formulated to meet, but not greatly exceed predicted energy requirements, during the dry period (controlled energy group, n=28), or a diet supplying about 150% of energy requirements (high energy group, n=28). In a third treatment, cows received the same controlled energy diet for the first 28 days after dry-off and a diet with an intermediate

Table 1. Ingredient and analyzed composition of the diets. C=controlled energy dry cow diet, I=intermediate energy dry cow diet, H=high energy dry cow diet, F=fresh cow diet

Item	C	I	H	F
Ingredient, % of DM				
Corn silage	28.5	42.2	55.9	44.2
Hay Crop Silage	-	-	-	10.7
Hay Switchgrass	-	-	-	2.7
Wheat Straw	35.6	24.0	12.4	-
Amino Plus®	10.5	6.0	1.5	4.5
Canola Meal	6.8	7.9	8.9	9.8
Ground corn	2.6	3.6	4.6	4.7
Rumensin 90®	0.01	0.01	0.01	0.01
Soy Chlor®	1.71	1.26	0.82	-
Other	14.29	15.03	15.87	23.39
Chemical Composition				
MP g/day[1]	1490	1520	1520	2649
NDF, % of DM	46.2	42.5	38.7	33.5
NFC, % of DM	29.3	34.6	39.8	37.7
Starch, % of DM	13.0	18.2	23.3	20.0

[1]Estimation of MP supply for average intake in each treatment group for the last seven weeks before calving and for overall average intakes postpartum (CNCPS, v.6.1)

FYI

■ **Sabine Mann** is a veterinarian and Ph.D. student in the College of Veterinary Medicine. **Daryl Nydam** is Director of QMPS Animal Health Diagnostic Center. **Thomas Overton** is Professor of Dairy Management in the Department of Animal Science at Cornell.

level of energy (about 125% of the estimated requirements) from 28 days before expected calving until the day of calving (intermediate energy group, n=28). Cows were entering second or greater parity.

Straw was chopped to a target length of two inches before mixing into the TMR. Diet composition is shown in Table 1. All cows received the same fresh cow TMR after calving (Table 1). Blood samples were taken three times per week in the close-up and fresh period. Non-esterified fatty acid (NEFA) and BHBA concentration were measured, as well as dry matter intake, milk production and composition.

Estimation of mean energy balance by CNCPS analysis for the whole dry period was 112, 126 and 153% of requirements and estimated supply of metabolizable protein was 124, 123 and 118% for those same groups.

Data from this study showed that cows fed a controlled energy diet throughout the whole dry period mobilized less adipose tissue as reflected by lower concentrations of NEFA in the first three weeks after calving (Table 2). They also had lower concentrations of BHBA postpartum while milk production and postpartum DMI intake were not affected. No cows were treated for clinical ketosis (BHBA ≥ 2.5 mmol/L) in the controlled energy group while four cows in the intermediate and five cows in the high group received treatment. There were twice as many events of subclinical ketosis (BHBA ≥ 1.2 mmol/L) in the intermediate and high energy groups compared to the controlled energy group in the first 21 days in milk.

Cows fed an intermediate energy level in a step-up system had the same milk yield and postpartum DMI as cows in the other two groups. When taking into account concentrations of NEFA and BHBA postpartum, as well as treatment for clinical ketosis and episodes of subclinical ketosis, cows fed an intermediate energy level in a step-up system prepartum showed some of the same effects of a more pronounced negative energy balance as cows fed a high energy diet for the whole duration of the dry period. Average immunoglobulin concentrations in colostrum were highest in the controlled energy group (96.2 g/L) and lowest in the high energy group (72.4 g/L, P=0.03).

Table 2. Least squares means for energy metabolites, DMI and milk yield.

Measurement		Dietary Treatment: Controlled	Intermediate	High	*SEM*	P
BHBA,	prepartum	0.29[a]	0.30[ab]	0.34[b]	0.01	0.04
mmol/L	postpartum	0.63[a]	0.77[ab]	0.85[b]	0.06	0.05
NEFA,	prepartum	237[a]	180[b]	175[b]	12	0.001
uEq/L	postpartum	659[a]	664[a]	796[b]	37	0.02
DMI, kg/d	prepartum	14.2[a]	15.3[b]	16.4[c]	0.3	0.001
	postpartum	22.3	22.4	22.4	0.6	0.99
Milk, kg/d		43.8	43.6	43.9	1.2	0.98
ECM, kg/d		46.1	47.0	48.3	1.2	0.48

[abc] *Row means with different superscripts differ (P<0.05)*

Although sample size in this study was not adequate to compare health events, epidemiological data linking high BHBA and NEFA concentrations to an increased risk for several periparturient disorders, including displacement of the abomasum, metritis, reduced reproductive success as well as decrease in milk production and removal from the herd has been described in several recent studies.

In this study, feeding a controlled energy diet throughout the whole dry period showed clear advantages to prevent excessive negative energy balance that could lead to downstream disease and improve colostrum quality without affecting milk yield.

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Reproduction and technology field studies

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mark behavioral.

Therefore, some of the objectives of our recently concluded research projects conducted at a commercial dairy farm include:

1-Comparing the timing required to identify cows with health disorders (metritis, subclinical and clinical ketosis, displaced abomasum, mastitis, milk fever, and lameness) using a combination of rumination and activity data and daily observations by personnel versus personnel alone;

2-Correlating rumination activity during the pre- and early post-fresh period with markers of metabolic status (NEFA's, BHBA's, Calcium) and systemic inflammation (Haptoglobin);

3-Characterizing early changes in feed intake based on rumination and behavior based on activity in cows undergoing health disorders; and

4- Correlating the daily variation in rumination with daily variation in milk yield during the first 90 DIM.

On-farm research studies are a necessary first step to determine the ability of novel technologies such as rumination and activity monitoring to enable earlier identification of cows with health disorders. Correlating rumination and activity with the occurrence of disease and different markers of metabolic status and inflammation, will allow identification of health monitoring and treatment strategies that maximize cow productivity and reproductive performance, and demonstrate the value of these technologies to dairy producers. We are currently working on evaluating the data generated in these studies so, stay tuned to hear about our findings! ❒